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Twenty-four children each at the age levels of 6, 9, 12, and 15 years were tested on four types of experimentally determined conceptual clues in a study of concept identification and, therefore, language comprehension. Superordinates, similars, parts, and locations were selected as clue words, and the four clues were combined into all possible pairs. The task was to retrieve 16 stimuli which were originally used in a restricted association study. The number of correct answers was found to increase as a function of age, clue types, and the number of clues given. Similars proved to be the most useful single clues. The results indicate that while different explanatory techniques for words are not necessary for different age levels, the type of relationship and the number of clues given are important determinants for concept identification. (MS)

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Age Differences in the Identification of Concepts of the Natural Language

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Traditionally, a term X, such as zebra, is described by generic definitions of the form "an X is a (Superordinate), e.g. animal, with (Attributes), e.g. stripes", or by typological definitions of the form "an X is like a (Similar-Coordinate), e.g. horse". The former definition has been regarded as a scientific one, the latter as one of common sense. In the past, neither the differences in efficiency of these definitions in transmitting information nor their dependency on either the words to be explained or the persons to be addressed have been taken into account. Moreover, no combinations other than Superordinates/Attributes have been considered although at least the Similarity relationship has been suggested for inclusion.

The present paper focuses on age differences in the identification of concepts or the meaning of words and, thus, deals with language comprehension. Concept identification will also be studied as a function of combining word relations in forms other than Superordinates/Attributes.

In a study of restricted word associations, Riegel, Riegel, Smith and Quarterman (1967) found that: (1) word relations become clearer and more independent with age and (2) when explaining words, a child, as he matures, moves from the usage of denotations of Parts or Locations to those of Similars or Superordinates. These findings imply that if the word association process is reversed (i.e. if an associative response is given as a clue word and Ss are asked to provide the original stimulus as the target word) performance should vary at least according to four factors: (1) age of Ss, (2) target word (original stimulus) to be identified, (3) associative strength between target word (original stimulus) and clue word (original response), and (4) number of clue words given.

Marilyn Zivian (1966) used this technique with college students and observed that Ss responded correctly more often (1) when Similar clues were given and less often when Location clues were given; (2) when high rather than low associates were used as clues; (3) the more clues they were given.

In the present experiment, age is the primary variable of investigation while association strength is held nearly constant. The main predictions are: (1) all Ss should produce approximately the same number of correct responses when given the Part or Location clues; (2) older children should get more correct answers with Superordinate or Similar clues than younger children; (3) younger children should do better with Part or Location clues than with Superordinate or Similar clues; (4) regardless of age, Ss will perform better the more clues given.

Procedures

Material. Words were chosen from the Michigan Restricted Association Norms (Riegel, 1965a) in which 100 college students responded to 200 stimuli each under 16 different instructions. The 16 tasks have been divided into three main categories: (1) logical, (2) grammatical, and (3) infralogical. In the present study, the concern is only with the infralogical tasks of Parts and Locations and the logical tasks of Superordinates and Similars. The term infralogical (Flavell, 1963) refers to a physical relationship in time or space. For example the Part clues, TOE has a spatial relationship to the whole denoted by the original stimulus FOOT. A logical relationship on the other hand implies verbal abstractions. For example, a Superordinate denotes an abstract category, such as ANIMAL, under which a number of items can be classified on the basis of common qualities, functions or parts, for instance ZEBRA, HORSE, COW, etc. Inhelder and Piaget (1958) hypothesize that both logical and infralogical relationships are well recognized and used by early adulthood.

Target Words. On the assumption that the responses of college students represent a standard which children will increasingly approximate, 16 noun stimuli were selected as target words from the Norms. The stimuli had been used successfully in an earlier study of restricted associations by Riegel, Riegel, Smith and Quarterman (1967) using 3rd and 6th grade students and occurred in a child's vocabulary by six years of age (Rinsland, 1945). Marilyn Zivian (1966) also used the same 16 stimuli.

Clue Words. Superordinates, Similars, Parts or Locations which did not occur as primary or high frequency responses to the same stimulus under any of the other three tasks were selected as clue words for each of the 16 target words. The mean association strength varied slightly between the four tasks and was somewhat lower for Parts (38%), Locations (36%), and Similars (34%), than for Superordinates (48%).

Clue Combinations. The four clues were combined into all possible pairs. No pair included the same clue twice. The pairs consisting of a Superordinate and a Similar clue and the pairs consisting of a Part and a Location will be called 2-way logical or 2-way infralogical clues, respectively. Any single clue will be called either a 1-way logical (Superordinate or Similar) or a 1-way infralogical (Part or Location) clue. The combinations of logical and infralogical clues will be called mixed clues.

Presentation. The clue words were inserted into the following sentence frames:

I am looking for something which	is a	(Superordinate)
	is like a	(Similar)
	has	(Part)
	can be found in	(Location)

The sentences for the clue combinations were derived by joining the dependent clauses of the single clue frames, as for instance:

I am looking for something which is a (Superordinate) and has (Part).

The experiment was presented to the children as a word guessing game. Each sentence was read to S and E recorded the answers on the test forms. If requested, the sentences were repeated once or twice, so that there was no time pressure. E recorded the time used by S for the completion of the whole list of items.

The 160 clue combinations were randomized for each S within the five categories: logical 1-way (32), logical 2-way (16), infralogical 1-way (32), infralogical 2-way (16), and mixed (64). The order of presentation of the five categories was counterbalanced to yield 24 different test forms. Each S within an age group received the test forms in a different order.

Subjects. The experimental setting was a mobile trailer which was taken to the schools for the testing. Ninety-six school children of about average intelligence were

tested in public schools in Ypsilanti, Michigan. There were 12 boys and 12 girls in each of the following age and grade levels: 6.4 year olds, 1st grade; 8.8 year olds, 3rd grade; 11.8 year olds, 6th grade; 14.8 year olds, 9th grade.

Results

The occurrence of the 16 target words in either singular or plural form, were counted as correct answers. No synonyms or phrases including the target words were regarded as correct. The percentages of correct answers given in Table 1 increase steadily up to the 6th grade. The percentages of the 9th graders are lower though they do not drop to the levels of the 1st and 3rd graders. The results were evaluated in the following three variance analyses. All main and interaction effects were found to be highly significant ($p < .001$).

Insert Table 1 about here

In the first analysis, comparisons were made between the four types of single clues and grades. For all grades Similars prove to be the most and Superordinates the least useful single clues. Parts and Locations are of medium efficiency. These results differ from Zivian's (1966) in that the order of correct responses for her college Ss was Similars, Superordinates, Parts and Locations, and that her Ss performed consistently better with single logical clues than with single infralogical clues. By pooling the types of clues accordingly and applying the t-tests, our 6th and 9th graders too, were found to perform significantly better with logical than with infralogical clues ($p < .01$ and $p < .05$, respectively. Since no significant differences were observed for the 1st and 3rd graders, we had to abandon the hypothesis that young children would do better with infralogical than with logical clues.

In the second analysis, comparisons were made between all six types of double clues and grades. Without exception, the order in efficiency of the clue combinations is for all grade levels: Similars-Locations, Similars-Parts, Similars-Superordinates, Parts-Locations, Superordinates-Parts, Superordinates-Locations. On the basis of t-test com-

parisons we had to reject the hypothesis that mixed clues would be more useful than pairs of either logical or infralogical clues. Instead, the 2-way logical clues take the third and the 2-way infralogical clues the fourth rank among the six combinations. Mixed clues are consistently superior when they include Similars, but inferior when they include Superordinates. Only the 9th graders reverse this pattern by performing significantly better on 2-way logical than on mixed clues ($p < .05$). Except for the 1st graders, all groups performed significantly better with 2-way logical than infralogical clues ($p < .05$).

Insert Figure 1 about here

In the third analysis, comparisons were made between the number of clues and grades. Although the main and interaction effects were highly significant, double clues were not more effective than single Similars (see Figure 1). When second clues were added to single Parts, Locations, or Superordinates, there was always a marked performance increment. The greatest improvement occurs when a Similar was added to any of the other clues. Further t-test comparisons failed to reveal any difference between single and double clues for the 1st graders. The other three grades performed significantly better with double than with single clues ($p < .01$, $p < .01$, $p < .05$, respectively).

The different clue types (logical, infralogical and mixed) were counterbalanced so that each could appear in one of three positions for the first time. When the percentage of correct responses were calculated for each position ignoring clue types, the 1st graders performed at a constant level. All of the other grades showed improvements for each successive position, but the increase was significant only for the 9th graders ($p < .05$). Thus a slight learning effect is indicated for the older children. However, the effect was not great enough to enable the 9th graders to perform better with 1-way clues. Two-way clues always yielded more correct answers than 1-way clues, regardless of their position.

As the percentage of correct responses increases with age, the percentage of errors (100% minus % of correct responses) and the number of different types of errors both de-

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crease. "Error" denotes all answers not identical with the stimuli of the norms, i.e. "errors" might include rather reasonable substitutes for the target words. In order to investigate this implication, the errors were checked against any responses listed to the original stimuli under any of the 16 tasks of the Michigan Restricted Association Norms. As shown in Table 2, the percentages of the errors which could be found in the norms increase with age. Only about one-quarter of all the different 1st grade errors occurred at least once in the college norms, while over half of the errors of the 9th graders could be located in the norms. The percentages of errors that can be regarded as reasonable substitutes for the target words increase beyond the level of maximum performance observed in the present study, e.g. beyond the 6th grade.

Insert Table 2 about here

The number of omissions, the number of different responses (types) and the time needed to complete the entire tasks were also analyzed. As shown in Table 2, the percentage of omissions is negligible but decreases steadily from the 1st to the 9th grade. The type token ratio, which is determined by dividing the total number of different responses by the total number of responses, is inversely related to the percentage of correct answers. Variability decreases from the 1st to the 6th grade with a slight increase for the 9th graders. This result is consistent with the findings by Riegel, Riegel, Smith, and Quarterman (1967), on the variability of restricted associations given by 3rd graders, 6th graders and college students. The magnitude of the type token ratios is, however, considerably larger at all grade levels in these tasks of language production than in the present ones of language comprehension. The time needed to complete the present tasks decreases from the 1st to the 9th grade.

Discussion

Two factors not controlled in the present study are of interest for interpreting Ss' performances. These are the free association strengths between the 64 clue words (original responses) and the target words (original stimuli) and the number of possible correct answers appearing in the Norms.

Searching through the available free association norms (Bousfield, Cohen, Whitmarsh and Kincaid, 1961; Palermo and Jenkins, 1964; Battig, 1965; Riegel, 1965b) 49 of the 64 clue words (original responses) given to our Ss were found among the stimuli. When free association strength between these 49 stimuli and the target words was correlated with the number of correct responses for all single clue conditions, significant results were found for all levels except the 1st graders (see Table 2).

The consistent increase in the correlations may suggest that older children find the correct responses more often than the younger ones by free associating to the clue words. The younger children on the other hand, may have tried to use the clue restrictions verbatim and subsequently took more time to complete the tasks. This interpretation is ambiguous however, since we had to rely on adults' free association norms for all our calculations. If the 64 clue words (original responses) could be located as stimuli of children's free association norms, the correlation coefficient for the 1st graders may have increased to the level observed for the older children.

The number of possible answers which could be elicited by the clue words was estimated by tabulating to how many of the 200 different stimuli of the Michigan Restricted Association Norms the clue words appeared as a response under the same task restriction. The correlations between the number of possible and the number of observed correct responses for single clues are given in Table 2.

The significant negative correlations for 3rd and 6th graders indicate that the greater the number of possible answers the less likely Ss are to give the correct one. However, the low correlations obtained for 1st and 9th graders have to be explained in a different manner. The estimated number of possible answers is again based on adult norms, and probably does not validly represent the size of the 1st graders' vocabulary. Therefore their correlation is close to zero. The number of possible answers is probably an appropriate estimate of the 9th graders' vocabulary. Since they are using, however, the least amount of time to complete the tasks they see to reduce the number of possible answers very quickly to small subsets which they consider correct, but which do not necessarily include

the target words sought. Subsequently, they tend to produce high percentages of "errors" which can be regarded as reasonable substitutes for the target words (see Table 2). That 9th graders focus more quickly than the other Ss upon particular subsets of possible answers, may be related to their ready use of free associations and an ability for complex and rapid information processing.

Free association strength and number of possible answers can also account for differences in efficiency between Similar and Part clues, on the one hand, Location and Superordinate clues on the other. The average free association strengths for these clue types are 11.8%, 11.8%, 2.0% and 3.5%, respectively. The average category sizes as defined by the number of possible answers are .44, 3.25, 13.1 and 8.0, respectively. Therefore, comparatively high free association strengths and small sets of possible answers can combine to account for the efficiency of Similar and Part clues. Low free association strength combined with large sets of possible answers explain the inefficiency of Location and Superordinate clues.

Conclusion

According to our results the Aristotelian type of generic definition is not the most efficient procedure for the identification of words. Definitions by types, synonyms, or similars lead more readily to correct identification, whereby the addition of other clues does not necessarily produce marked improvements but--in the case of 1st graders--reduces the level of performance. Generally, Ss performance was markedly improved, however, when double instead of single clues were given. This effect was particularly strong when a second clue was added to Superordinate or Location clues. It made relatively little difference when a Part or Location clue was added to the Superordinates, but the addition of a Similar led to important improvements. This again questions our preference for generic definitions.

Similars were the most useful single clues and, indeed, the performance of 1st graders was best for single Similar clues than for any other single or double clues. This exceptional finding might be explained by a lack in short-term retention and the

inability of 1st graders to process simultaneously the two types of information provided by paired clues. Comparable interpretations are implied in McLaughlin's (1963) attempt to explain differences in cognition of children at various developmental stages by differences in their ability to perform simultaneously different categorizations and, ultimately, by the growth of their retention span.

With the exception of the Similars, however, the performance at the different grade levels was closely comparable. There was, to be sure, a considerable increase in performance with age, but the order of both singles and double clues in terms of their usefulness for the identification of the target words was precisely the same for all grade levels. This result indicates that there is no need to use different explanatory principles or educational techniques for the elaboration of concepts at various grade levels. Explanations at the younger age levels should be limited, however, to a few discrete hints rather than to simultaneous presentations of different clues which might be too heavy a burden on the child's storage and combinatory abilities. It should be noted, of course, that our tasks of concept identifications are not precisely the same as the attempt to explain the meaning of unknown words to a person. In all our inquiries the target words were well within the vocabulary of our Ss.

Summary

Twenty-four school children each at the age levels of 6, 9, 12 and 15 years were tested on four types of experimentally determined conceptual clues. The task was to retrieve 16 stimuli which were originally used in a restricted association study. The number of correct answers was found to increase as a function of age, clue type and the number of clues given. The results indicate that while different explanatory techniques for words are not necessary for different age levels, the type of relationship and the number of clues given are important determinants for concept identification.

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Table 1

Percent of correct responses as a function of types of clues, number of clues and grade levels.

	1st	3rd	6th	9th
Single Clues Average	20.0	26.0	36.2	33.6
Similars	41.4	50.8	73.2	65.9
Parts	21.6	25.0	33.6	32.3
Locations	9.4	14.8	19.3	19.3
Superordinates	7.6	13.3	18.8	16.8
Double Clues Average	26.9	41.0	59.3	55.2
Similars - Locations	35.4	54.1	80.2	70.5
Similars - Parts	34.6	52.6	73.6	69.7
Similars - Superordinates	34.1	50.3	69.8	67.7
Parts - Locations	24.2	33.9	53.4	52.9
Parts - Superordinates	19.5	30.2	41.4	41.6
Locations - Superordinates	13.8	24.7	37.2	28.6
Total Average	24.2	35.0	50.0	46.5

Table 2

Various response measures as a function of grade levels.

	1st	3rd	6th	9th
Error Percent Listed in Norms	23.3	31.9	41.9	52.4
Percent Omissions	2.4	1.1	.9	.4
Type Token Ratios	.49	.39	.25	.27
Test Duration (min.)	32.6	33.0	28.7	18.3
Correlation 1	.14	.32*	.55*	.54*
Correlation 2	-.07	-.26*	-.89*	-.14

Correlation 1: Free association strength x percent correct answers (N = 49).

Correlation 2: Number of possible correct answers x number of observed correct answers (N = 64).

* Significantly different from zero at $p < .05$.

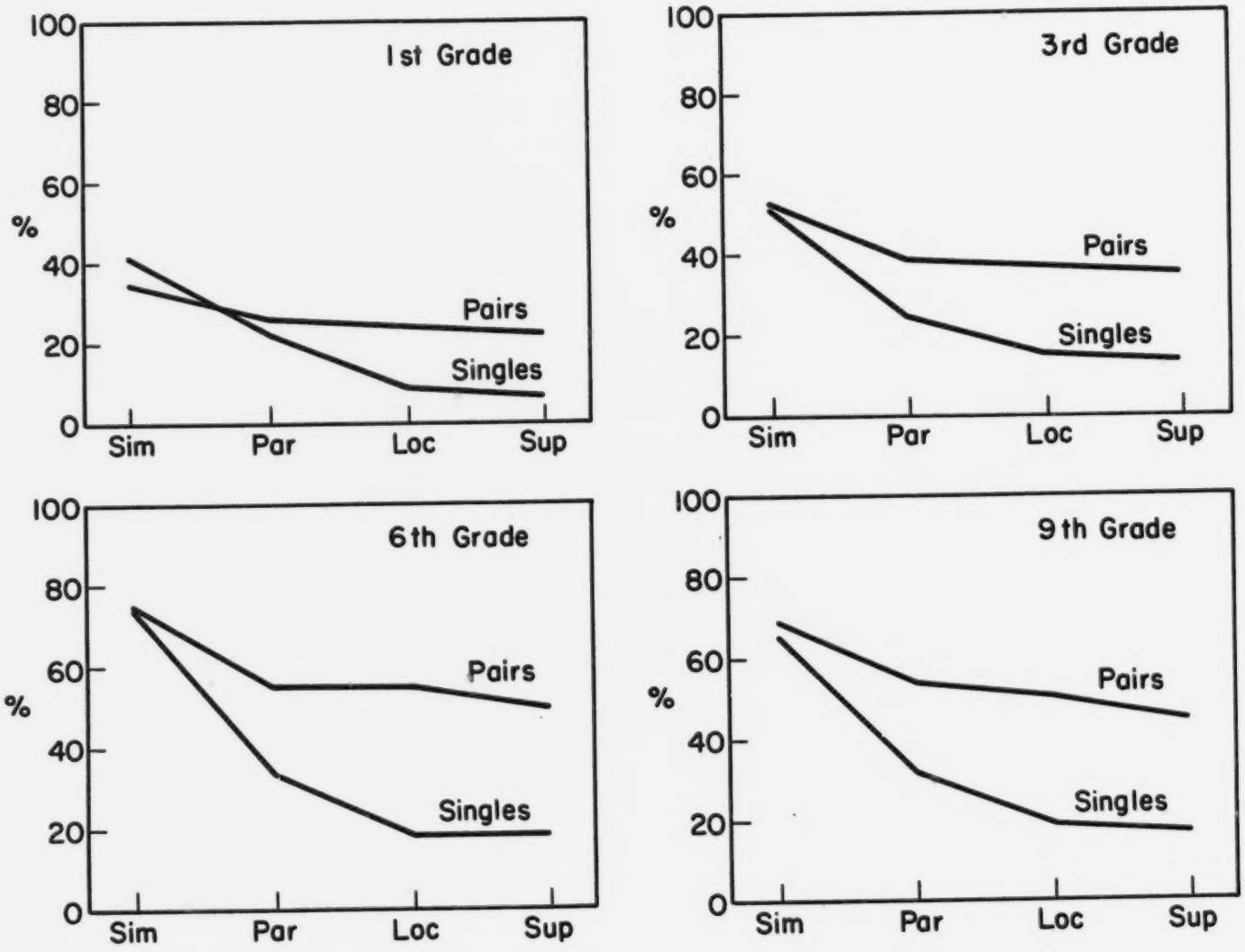

Fig. 1. Percent of correct identification of stimuli when clues were given either singly or in pairs with any of the other three clues.